

magnetism, or strength of a pole; magnetic potential; electrokinetic momentum of a circuit; electric current.

ζ. Atomic energy, or energy of unit volume, can be compared with Earth's photodynamic energy of unit volume, $\frac{m_3 L_o^2}{r_3^3 T_o^2} = \frac{m_3}{L_1 T_o^2}$, and with corresponding electric energies, through the equations

$$[\mathfrak{D} \mathfrak{E}] = [\mathfrak{B} \mathfrak{H}] = [\mathfrak{C} \mathfrak{A}] = \frac{M}{L T^2}$$

The bracketed symbols represent, respectively, electric displacement (measured by surface-density); electromotive force at a point; magnetic induction; magnetic force; current electric intensity at a point; vector potential of electric current.

η. Electrochemical and electromagnetic energies may be compared with thermal, photodynamic and other energies, through the proportion

$$\chi : \mu :: M_o t_a^2 \times M_o v_3^2 : m_3 t_n^2 \times m_3 V_o^2$$

I designate Weber's units of electrochemical and electromagnetic force by χ and μ , respectively; t_a is the time of acquiring orbital velocity, or incipient associative energy, at Laplace's limit of equal velocities of rotation and revolution; t_n is the time of acquiring nuclear nascent or dissociative velocity.

$$t_a : t_n :: 1 : \pi$$

θ. Total magnetic force, φ_o , can be compared with the reactions of terrestrial magnetic force, φ_3 , by the proportion

$$M_o^2 : \pi^4 m_3^2 :: \varphi_o : \varphi_3$$

The reactions of orbital tendency are $t_a M_o^{\frac{1}{2}}$, $t_n m_3^{\frac{1}{2}}$, respectively; centripetal acceleration varying as the fourth power of orbital velocity, we have the ratio, $M_o^2 : \pi^4 m_3^2$.

(Contributions from the University of Pennsylvania, No. 16.)

On Alaskaites, a new member from the series of Bismuth Sulphosalts. By Professor George A. König.

(Read before the American Philosophical Society, June 17, 1881.)

Mode of occurrence. The high mountain mass of south-western Colorado culminates in Mt. Sneffels at an altitude of 14,156 feet. But this great height does not impress itself upon the observer since the deepest valleys are still 7000 feet above the sea. The geological structure of these mountains is very simple as a whole; but the energetic action of the forces of erosion, has produced a very rich and picturesquely carved topography, there being no table mountains, but only steep peaks and sharply indented crests. Mineral veins in clearly defined outcrops intersect these moun-

tains in astonishing abundance. They are easily traced on the bald slopes, which rise from one to three thousand feet above timber line. The geology, as already stated, is quite simple. Orthoclastic eruptive rocks—Quartz-porphry, Porphyrite and Trachyte—overlie granitoid metamorphic schists (chiefly gneiss) as an enormous sheet one mile thick. Only towards the West we find palæozoic rocks, sandstones, limestone and coal beds, lying between the crystalline top and bottom rocks, not exceeding probably 500 feet in thickness. All the peaks and crests visited by me were found to be made up of porphyritic rocks, schists and sedimentary rock being only found in the deep cañons. The silver bearing veins I found to be confined to the eruptive rocks with but few exceptions, *i. e.*, the “mineral farm,” near Ouray in Silurian limestone; the “black Wonder mine” and some other veins in Burough’s Park, which lie in granitoid gneiss.

One of the most interesting sections of this wonderful region is *Poughkeepsie Gulch*, one of the head forks of the Uncompaghre river. Here we find numerous veins in a bleak wilderness directly under the pass which leads from the Uncompaghre valley over into the Cement creek, one of the feeders of the Animas river. Very prominent among its neighbors is the *Alaska* vein which was opened by two adits at the time of my visit last August. The vein is well defined, striking nearly north and south, with almost vertical dip. The breast of the lower adit showed beautiful ore. Nests of gray copper and Alaskaitite in a gangue of quartz and barite. Even with candle light the gray copper and Alaskaitite (Bismuth silver ore so called here) are distinguishable, and are separated by handpicking into first class, and second class ore. I found some difficulty in procuring specimens, as the foreman had orders not to allow specimens being taken away.

Physical properties of Alaskaitite. The specimens consist of a more or less intimate mixture of the new mineral with barite and chalcopryrite, and sometimes a little quartz. Neither blende nor galenite could be detected. The small quantity of antimony shown by the analysis might be due to the presence in the mixture of some gray copper or other Stibiosulphosalts, or may be replacing bismuth in the Alaskaitite. But could in no way interfere with the correct definition of the new mineral, as will be seen later. The complete decomposition with hydrochloric acid speaks quite in favor of the latter view.

The structure of Alaskaitite is small foliated, some smooth cleavage planes may be observed here and there. Its color is whitish lead-gray, approaching bismuthinite; its lustre strongly metallic; opaque. Color of the fine powder is bluish-gray. The structure forbids a determination of hardness, but the mineral is mild in the mortar, and easily friable.

The *specific gravity* was determined with the fine powder used for the Analyses C and D, and found to be 6.878 by the following calculation :

Let $S = 1^s.3165 = A + B + C$ (Alaskaitite + barite + chalcopryrite)
 then we have $p = \frac{A}{\delta} = \frac{S-B-C}{\delta_1-\delta_2}$

The analysis gives $B = 0.15$; $S = 0.1975$; $C = 0.228$; $S = 0.0301$
 $\delta_1 = \frac{0.1975}{4.486} = 0.044$; $\delta_2 = \frac{0.0301}{4.2} = 0.0072$

$A = 0.2095$ by experiment.

hence $S-B-C = A = 1.0889$; $\delta = A - \delta_1 - \delta_2 = 0.1583$

and $p = \frac{1.0889}{0.1583} = 6.878$.

Blowpipe reactions. The mineral decrepitates in the closed tube, similarly to the majority of compounds belonging to this group, it melts then at red heat without the formation of a sublimate. Heated with the O. Fl. on charcoal it yields a deep yellow incrustation with a white non volatile fringe, coloring the seam of the flame faintly azure blue (lead). Upon continued blowing a crimson to peach blossom red zone appears between the yellow and white incrustation (silver). The residue gives the reactions of copper and iron with borax and microcosmic salt, and after cupellation with lead, a considerable silver button. With potassium iodide and sulphur an intense brick red coating is obtained (bismuth). In the open tube sulphurous anhydride (sulphur) and a minute white sublimate (antimony) are given off, while a yellow residue is produced. Cold concentrated hydrochloric acid acts very slowly upon the finely pulverized mineral, but the heated acid decomposes it completely and rapidly, leaving flocculent silver chloride.

Analyses. So intimate is the mixture of Alaskaite and chalcopyrite, that a complete mechanical separation was not feasible. Now it is quite possible to remove the Alaskaite by HCl from the chalcopyrite and barite, but the quantity of copper-iron-bisulfide is always so small (see analyses) that if the iron be taken as representing chalcopyrite, no appreciable error will be committed. A small quantity of the mineral was picked out carefully, leaving only traces of chalcopyrite, for a preliminary analysis. 250 mg. gave: $Bi_2O_3 = 160.0$ mgr; $PbSO_4 = 38.0$ mgr. $Ag\ Cl = 23.5$ mgr; $CuO = 7.0$ mgr; birite = 8.3 mgr. The substance minus barite was 141.7 mg. Calculated upon this number we have:

$Bi_2S_3 = 73.02$; $PbS = 12.40$; $Ag_2S = 9.06$; $Cu_2S = 6.20$ corresponding very closely to the ratio $(RS)_{20} + (Bi_2S_3)_{21}$ that is probably as 1 : 1. A quantitative blowpipe assay gave 7.5 p. c. Ag, or minus barite, 8.90 Ag_2S .

With less carefully picked material the following 2 analyses were made, A and B, the determinations of Bi and Pb in A being lost:

	A (1 ^g .5000)	B (1 ^g .0000)
Insoluble	0.2382	0.1551
AgCl	0.1337	0.0945
CuO	0.0710	0.0462
Fe ₂ O ₃	0.0220	0.0168
ZnO	0.0040	0.0030
BiClO	—	0.4945
Bi ₂ O ₃	—	0.0385
PbSO ₄	—	0.1480
BaSO ₄	—	0.9683

Deducting the insoluble (barite) we obtain per cent.

	A	B	Mean.
Bi =	—	51.49	51.49
Pb =	—	12.02	12.02
Ag =	7.97	8.19	8.08
Cu =	4.49	4.37	4.43
Fe =	1.22	1.40	1.31
Zn =	0.24	0.29	0.26
S =	—	17.20	17.20
			<u>94.79</u>

Deducting again Fe = 1.31 ; Cu = 1.48 ; S = 1.48 as chalcopyrite, we obtain for Alaskaité

Bi =	51.49	:	208	=	0.2475	
Pb =	12.02	:	207	=	0.0585	
Ag =	8.08	:	216	=	0.0374	} 0.1236
Cu =	3.00	:	126.4	=	0.0237	
Zn =	0.26	:	65	=	0.0040	
S =	15.72	:	32	=	0.4912	

that is 0.1236 R : 0.2475 Bi : 0.4912 S = 1 : 2.002 : 3.974

Notwithstanding the simple ratio, this result cannot be utilized to base definite conclusions thereon, since there is an unaccounted loss of nearly 5 per cent. in the analyses. From the same specimen material was now taken off another corner, and 2 analyses made as follows :

	C (1 ^g .000)	D (1 ^g .0000)	Mean.
Bi =	47.27	46.47	46.87
Sb =	0.51	—	0.51
Pb =	—	9.70	9.70
Ag =	7.19	7.01	7.10
Cu =	3.54	3.75	3.64
Fe =	0.70	0.70	0.70
Zn =	0.56	0.72	0.64
S =	15.85	—	15.85
Insoluble =	14.90	15.10	15.00
			<u>100.01</u>

Taking the iron again as coming from chalcopyrite we deduct 0.79 Cu and 0.79 S, leaving

Bi =	46.87	:	208	=	0.2253	} 0.2294
Sb =	0.51	:	122	=	0.0041	
Pb =	9.70	:	207.2	=	0.0468	
Ag =	7.19	:	216	=	0.0342	} 0.1133
Cu =	2.85	:	126.4	=	0.0225	
Zn =	0.64	:	65	=	0.0093	
S =	15.07	:	32	=	0.4709	} 0.4709
(Fe ₁ Cu)S ₂ =	2.28					
Barite =	15.00					

hence R : Bi : S = 1 : 2.020 : 4.14

The composition of Alaskaite is therefore in 100 parts

Bi	=	56.97
Sb	=	0.62
Pb	=	11.79
Ag	=	8.74
Cu	=	3.46
Zn	=	0.79
S	=	17.63

100.00

This latter result must be taken as establishing the nature of Alaskaite, beyond reasonable doubt.

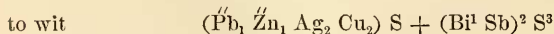
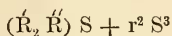
But on examining some other specimens qualitatively, which appeared to be identical in physical characters with the preceding one, I could not at first produce the crimson silver coating. Suspecting an essential difference I made upon the same powder three analyses the mean of which (closely agreeing) is as follows :

Bi	=	51.35	Bi	=	51.35	:	208	=	0.2468
Pb	=	17.51	Pb	=	17.51	:	207.2	=	0.0845
Ag	=	3.00	Ag	=	3.00	:	216	=	0.0138
Cu	=	5.38	Cu	=	3.74	:	126.4	=	0.0295
Fe	=	1.43	Zn	=	0.20	:	65	=	0.0030
Zn	=	0.20	S	=	16.21	:	32	=	0.5080
S	=	17.85	(Cu Fe) S ₂	=	4.71				
Insoluble	=	2.83	Barite	=	2.83				
		99.55							

$$R : Bi : S = 1 : 1.887 : 3.883 = 1 : 2 : 4$$

This then is the same mineral, except that the greater part of the silver is replaced by lead.

We have then in Alaskaite a complete type of the sulphosalts of the first order, according to Rammelsberg's symbol :



Of this type several members are known, but the copper bismuth glance from Schwarzenberg, and perhaps Domeyko's ore from Copiapo contain bismuth exclusively on the negative side.

The crystallographic symmetry of all the members of this type is probably *orthorhombic*.

A specimen from the Alaska mine, which had been sent to me as bismuth silver-ore, being composed of quartz, barite, chalcopyrite and what

appeared to be gray copper was pulverized as a whole, and analyzed with the following result :

		Calculated			
Sb	= 10.10	Sb_2S_3	= 13.68 : 340 = 0.0402	}	0.0530
Bi	= 5.05	Bi_2S_3	= 6.59 : 512 = 0.0128		
Cu	= 14.97	Cu_2S	= 17.01 : 126 = 0.1076	}	0.1673
Pb	= 3.84	PbS	= 4.04 : 239 = 0.0169		
Ag	= 0.70	ZnS	= 3.84 : 97 = 0.0396		
Zn	= 2.56	Ag_2S	= 0.80 : 248 = 0.0032		
Fe	= 1.23	$(\text{Cu}_1 \text{Fe}) \text{S}_2$	= 4.03		
S	= 11.53	Quartz, etc.	= 48.55		
Insoluble	= 48.55				
					98.55

If the gray substance be considered homogeneous then its molecular ratio will be

$$\text{RS} : \text{r}^2\text{S}^3 = 3.1 : 1$$

But gray copper has the ratio of 4 : 1. If the bismuth sulphide be now eliminated with the corresponding positive sulphide in the Alaskaite ratio of 1 : 1, then we get for the ratio of the rest

$$\text{RS} : \text{Sb}_2\text{S}_3 = 3.86 : 1$$

that is nearly the gray copper ratio.

It is made even more probable that such a mixture be here in existence, by qualitative tests upon a large specimen, weighing several kilograms of the massive gray mineral. These tests indicated very varying percentages, by the intensity of bismuth reaction from different points of the piece.

It is a matter of remark from a genetic point of view, that we find in this vein nests of Alaskaite quite free from the gray copper, while the latter seems to be mixed generally with the former in other places whenever it predominates.

The Auriferous Gravels of North Carolina. By H. M. Chance, M.D.

(Read before the American Philosophical Society, July 15, 1881.)

The belt of auriferous gravel stretching in an almost unbroken line from the New England States to Alabama, is broadest in North Carolina, where it has also been more productive in the past, and promises greater results in the future than in any other State through which it passes.

Yet notwithstanding the flattering prospects apparently presented by these gold fields, the companies organized to work them have rarely at-